May 2000 Monthly Report on
"Evaluation of ARPS Forecast Capabilities"
Task 3.10.1.2 of the FAA Convective Weather PDT

Task 3.10.1.2 is part of the overall effort to study "2-6 Hour National Forecast for Large Organized Storms" and involves a comparison of model forecasts of composite reflectivity or VIL for strongly forced, organized convection in the terminal area. In particular, CAPS's ARPS model and MIT-Lincoln Lab's Growth and Decay Tracker (GDT) will be compared.

a. *Current Efforts* (month just completed)

Collaborators from CAPS and NSSL have met to discuss how best to evaluate the capabilities of ARPS, GDT, and other forecast models and the following decisions or points of discussion have been made:

1) Careful attention has been given to the selection of up to 6 convective weather cases that would be appropriate for the current study. These 6 cases are among those originally proposed within "Comparison of Deterministic Thunderstorm Prediction with the Statistical Growth and Decay Tracker" submitted by CAPS. CAPS will provide NIDS data used to initialize and verify each case to NSSL. (A list of all cases including a brief synopsis and status of ARPS data and available radar data can be obtained at http://www.nssl.noaa.gov/~porter/cwpdt00/cases.pdf)

2) The first case that will be analyzed involves a squall line that moved through the Wichita, KS area during the late afternoon of May 20, 1999. NIDS data for this event has been obtained by CAPS and distributed to NSSL. An archived 3-km ARPS forecast has been produced, which had been generated as part of a CAPS operational test last spring.

3) There has been some discussion on whether to use composite reflectivity or VIL as the verifying model parameter within this study. Historically VIL has been used within the GDT but CAPS has been verifying composite reflectivity after running into problems trying to employ VIL calculations. It has been decided to use composite reflectivity, and, therefore, modifications will need to be made to GDT although they should not be extensive.

4) CAPS uses NIDS data to initialize ARPS but the current version of GDT at NSSL utilizes Level-II base radar data that contains higher resolution. Therefore, GDT will be modified to obtain NIDS data input so a more constructive comparison between the two models can be made. If time permits, the GDT will also be initialized with Level-II data to determine if any significant differences in the simulation are produced versus NIDS-initialized simulations.

5) Composite reflectivity forecast products will be statistically analyzed with respect to NIDS truth data using CAPS's verification software. The verification algorithm (created

under funding from MIT-LL last year) will be used to quantify the skill of the ARPS forecast. Skill will be based on the "fuzzy" logic approach as defined in Hallowell (1999), which assesses the forecast based on the prediction of reflectivity (> 40 dBZ) as compared to available composite Level-III (NIDS) radar reflectivity data. This technique will measure forecast skill using probability of detection (POD) and false alarm rate (FAR) scores as well as Critical Success Index (CSI) calculations.

6) ARPS will use Keith Brewster's Phase-Correction data assimilation procedure to improve its model forecasts. This method is designed to optimally shift model forecast convection and minimize overall differences with observations such as composite reflectivity and VIL (Brewster 1998).

7) A couple of issues have been raised that need to be considered when analyzing forecasts so that meaningful comparisons can be made. For example, at what point in a mesoscale convective system's lifetime should the ARPS and GDT models be initialized? If convection is in the very early stages of developing, then the GDT is put at a disadvantage since it can only work with composite reflectivity data that already exists. However, ARPS will be put at a disadvantage if it has to undergo a "spin-up" process before producing an accurate simulation of composite reflectivity. Both of these disadvantages could be considered as part of the make-up of both systems, and, therefore, something that should be incorporated within the study. Or the scope of this project may need to be narrower so that the development and propagation of mature, pre-existing convection only should be investigated.

b. *Planned Efforts* (for next reporting period)

1) Issues raised in point 7 of section **a** will be addressed immediately so that analysis of the May 20, 1999 case can begin. An ARPS simulation has already been obtained while a GDT simulation will be produced using the same Level-III (NIDS) initial condition radar data set assimilated by ARPS. Assessment of forecast skill will be made using CAPS's "fuzzy" logic verification technique. As time permits, further data cases will be investigated.

2) Additional model(s) beyond ARPS and GDT, such as MM5 and possibly a high-resolution meso-ETA model, will also be used in this study. However, MM5 does not explicitly predict VIL or composite reflectivity, therefore, a suitable surrogate will need to be found.

c. *Problems/Issues/Schedule Changes Encountered or Anticipated*

None.

References

Brewster, K., 1998: Phase-correcting assimilation of radar data for thunderstorm forecasting. Preprints, *12th Conf. on Numerical Weather Prediction*, Phoenix, AZ, Amer. Meteor. Soc., 181-184.

Hallowell, R.G., et. al., 1999: The Terminal Convective Weather Forecast Demonstration at the DFW International Airport. *Preprints*, 8th Conf. on Aviation, Range, and Aerospace Meteorology, Dallas, TX, AMS, Boston, MA.